IB DIPLOMA PROGRAMME
PROGRAMME DU DIPLÔME DU BI
PROGRAMA DEL DIPLOMA DEL BI

N04/4/BIOLO/HP3/ENG/TZ0/XX+

88046003

BIOLOGY
HIGHER LEVEL
PAPER 3

School code

Thursday 11 November 2004 (morning)

Candidate code

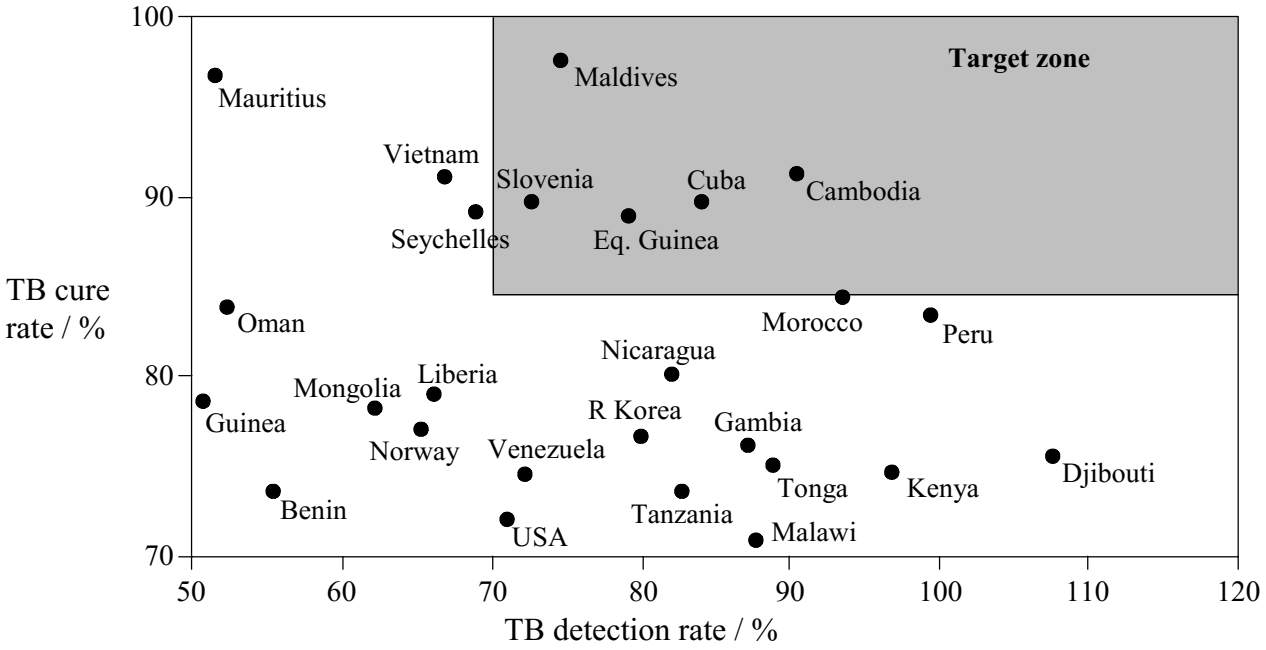
1 hour 15 minutes

INSTRUCTIONS TO CANDIDATES

- Write your school code and candidate code in the boxes above.
- Do not open this examination paper until instructed to do so.
- Answer all of the questions from two of the Options in the spaces provided. You may continue your answers on answer sheets. Write your school code and candidate code on each answer sheet, and attach them to this examination paper and your cover sheet using the tag provided.
- At the end of the examination, indicate the letters of the Options answered in the candidate box on your cover sheet and indicate the number of answer sheets used in the appropriate box on your cover sheet.

Option D – Evolution

D1. The World Health Organisation (WHO) published a report on multi-drug resistant tuberculosis (MDR TB). MDR TB is defined as disease caused by strains of *Mycobacterium tuberculosis* resistant to the two most important anti-TB drugs. It is largely a man-made phenomenon. The chart shows the cure and detection rate of tuberculosis (including MDR TB) in 26 countries, and a target zone defined by the WHO.



[Source: WHO Report, (1998), *Global Tuberculosis Control*, page 23]

(a) Identify the country outside the target zone with *[1]*

(i) the lowest TB cure rate. . . . . .

(ii) the highest TB cure rate. . . . . .

(b) Calculate the percentage of **all** cases of TB in Benin that are cured. *[1]*

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(This question continues on the following page)

(Question D1 continued)

(c) Suggest **two** reasons why countries should aim to be in the target zone. *[2]*

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(d) Explain how resistance to anti-TB drugs may have developed in *M. tuberculosis*. *[3]*

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D2. Aerobic bacteria are considered to be the most likely ancestors of mitochondria.

(a) State the name of the theory which suggests that mitochondria have evolved from a free-living organism. *[1]*

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(b) Outline the characteristics of mitochondria that would support the theory. *[2]*

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D3. (a) The term *species* is defined as a potentially interbreeding population having a common gene pool and producing fertile young. Outline why this definition cannot be applied to all living organisms. *[4]*

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(b) Discuss **two** ideas about the pace of evolution. *[6]*

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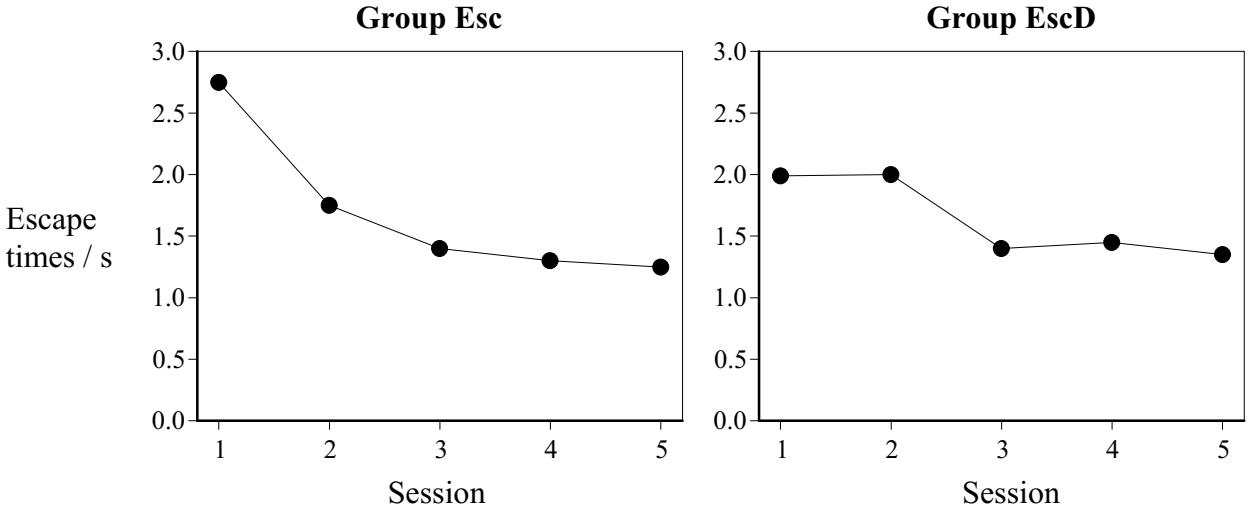
Option E – Neurobiology and Behaviour

E1. Two groups of 15 rats were trained to escape from an electric shock that was applied to one compartment of their cages. For one group (labelled EscD) the shock coincided with switching off the light, resulting in darkness in that compartment. The training was repeated for five sessions. The graphs below show the mean results for the two groups.



[Source: K Zielinski and A Savonenko, (2000), *Acta Neurobiol. Exp.*, **60**, pages 457–465]

(a) (i) Calculate the difference in escape times in session 1 between the two groups. *[1]*

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(ii) Suggest a reason for the difference. *[1]*

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(b) (i) Compare the changes in escape times over the five sessions between the two groups. *[2]*

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(ii) Deduce, giving a reason, which group shows more evidence of learned behaviour. *[1]*

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(This question continues on the following page)

(Question E1 continued)

(c) If the researchers were to continue their experiments with the group Esc and apply the same experimental conditions as for the group EscD, predict what would happen to the escape times for the group Esc. *[1]*

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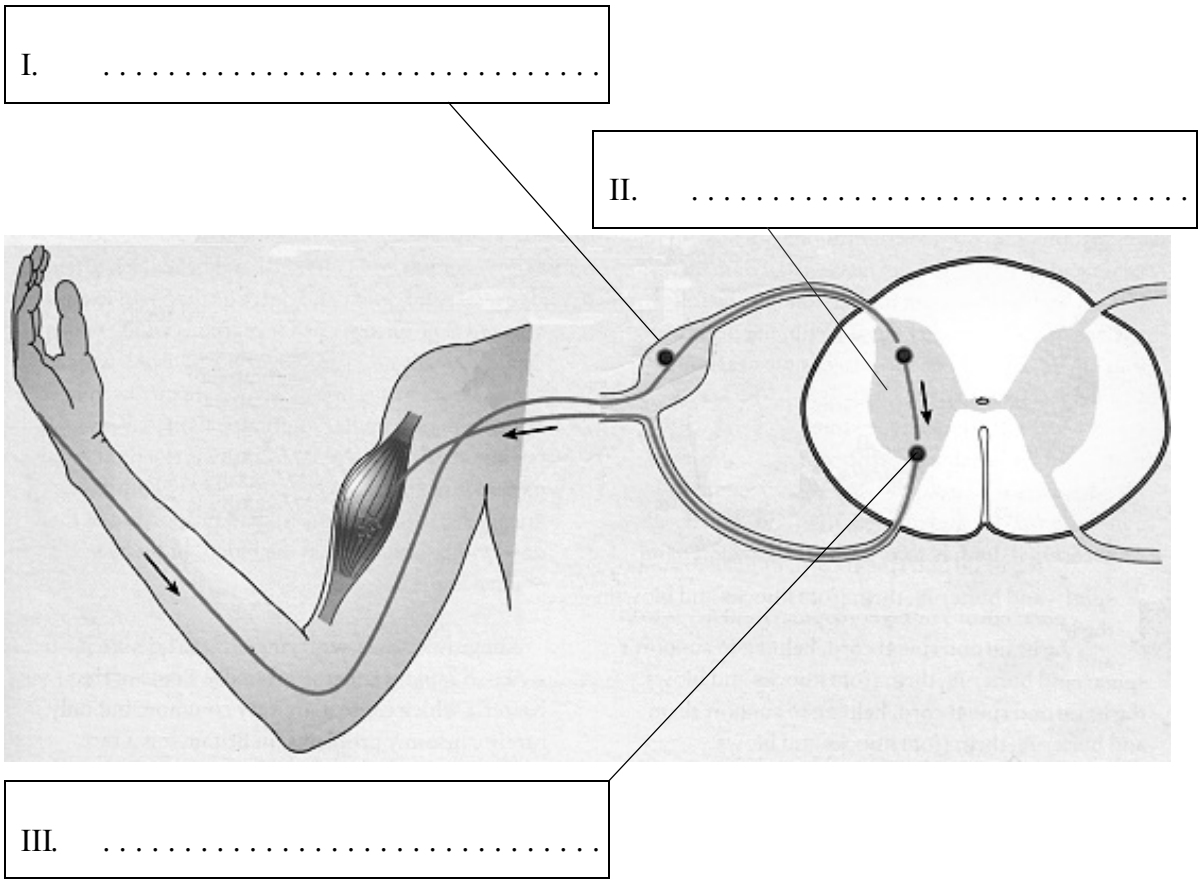
E2. The diagram below shows the components of a reflex arc.

(a) State the names of the **three** labelled structures. *[2]*



[Source: adapted from M Jones and G Jones, (1997) *Advanced Biology*, CUP, page 301]

(b) Explain the uses of reflexes in testing for brain death. *[2]*

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E3. (a) Discuss, using named examples, how the process of learning improves an animal's chance of survival. *[4]*

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(b) Describe the effects of the sympathetic and parasympathetic systems on the control of the heart and the iris of the eye. *[6]*

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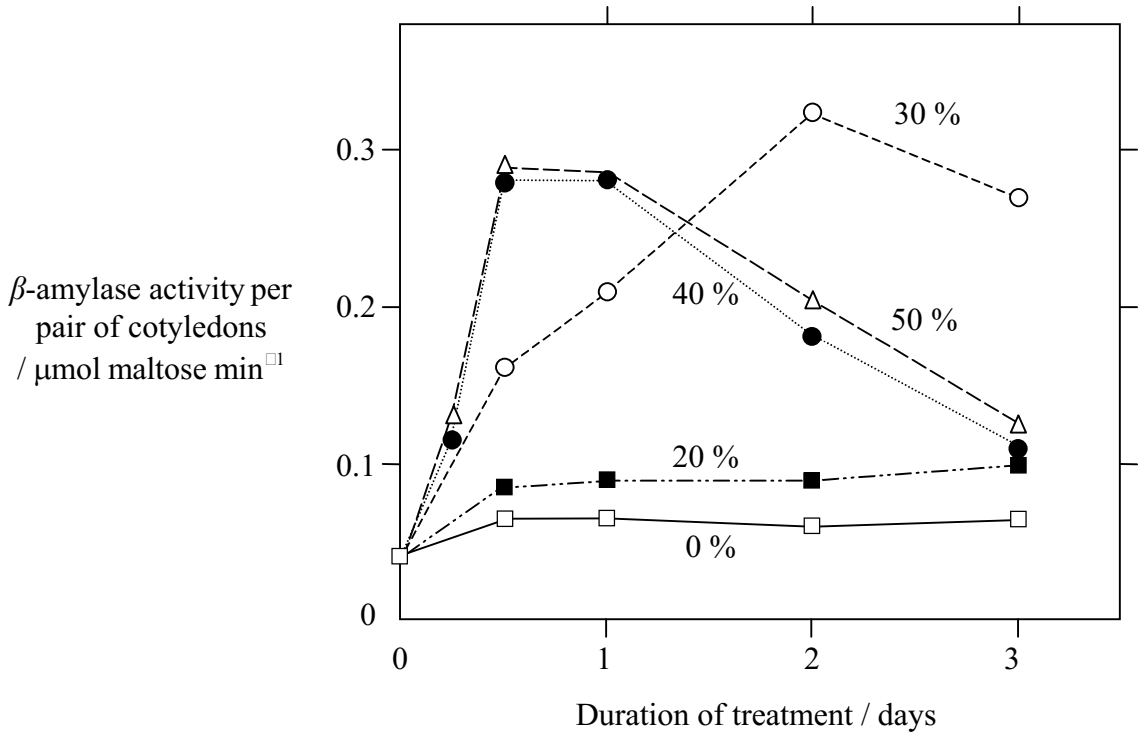
Option F – Applied Plant and Animal Science

F1. An experiment was carried out to investigate the effect of water stress on cucumber *(Cucumis sativus)* seedlings. Cotyledons were detached from four day old seedlings and treated with polyethylene glycol (PEG), a water absorbing compound. *β*-amylase activity was measured in cotyledons treated with PEG at concentrations of 0, 20, 30, 40 and 50 %. This enzyme catalyses the conversion of starch into maltose. The mean results are shown in the graph.



[Source: D Todak, *et al*., (2000), *Journal of Experimental Botany*, **51**, pages 739–745]

(a) Identify the maximum activity of *β*-amylase in the 50 % treatment. *[1]*

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(b) Compare the *β*-amylase activity in the cotyledons treated with 20 % PEG with those treated with 30 % PEG. *[2]*

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(This question continues on the following page)

(Question F1 continued)

(c) Deduce the relative free sugar content of the cotyledons treated with 20 % PEG compared to those treated with 30 % PEG. *[1]*

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(d) Suggest reasons for the change in activity of β-amylase during water stress. *[2]*

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F2. (a) State **two** ways in which plant productivity can be measured. *[2]*

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(b) Outline the effect of carbon dioxide concentration on plant productivity. *[2]*

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F3. (a) Outline the techniques used in cloning plants by micropropagation. *[4]*

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(b) Discuss the use and misuse of antibiotics and growth hormones in livestock rearing. *[6]*

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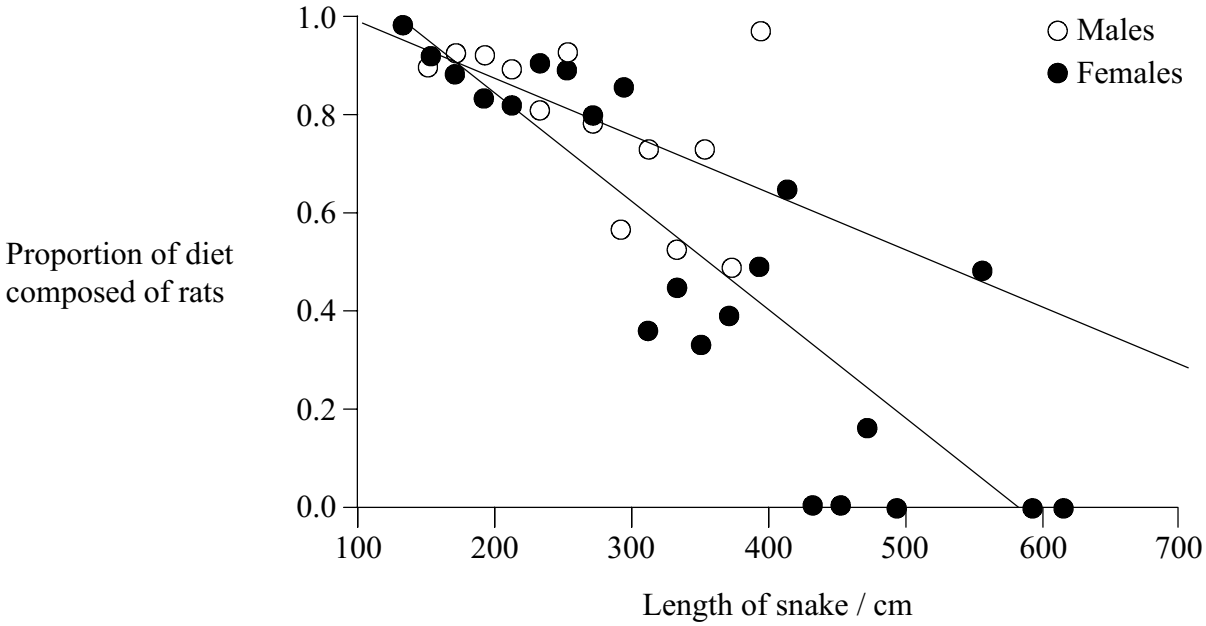
Option G – Ecology and Conservation

G1. The reticulated python *(Python reticulatus)*, a species of snake, consumes rats as part of its diet. The graph shows changes in the proportion of rats in the diet of male and female reticulated pythons from southern Sumatra as the length of the snake increases.



[Source: R Shine, *et al.,* (1998) *Functional Ecology,* **12**, pages 248–258]

(a) Identify the relationship between the proportion of diet composed of rats and the length of female pythons. *[1]*

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(b) Compare the feeding preferences of female and male pythons of lengths between

(i) 100 and 300 cm. *[1]*

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(ii) 300 and 400 cm. *[1]*

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(This question continues on the following page)

(Question G1 continued)

(c) Suggest **two** reasons for the differences in feeding preferences of the pythons as length increases. *[2]*

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The snakes were bought at local markets and skinning factories in Sumatra. Therefore, the origin of the individual snakes was not known. Estimations about prey size and species were made from fur and skeletal remains in the gut of the snakes.

(d) Suggest **two** factors that could influence the reliability of the results of this investigation. *[2]*

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G2. Discuss the difficulties in obtaining quantitative data needed to promote fish conservation. *[3]*

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G3. (a) Outline the roles of bacteria in the nitrogen cycle. *[6]*

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(b) Discuss, giving named examples, the difficulties of placing organisms in higher trophic levels. *[4]*

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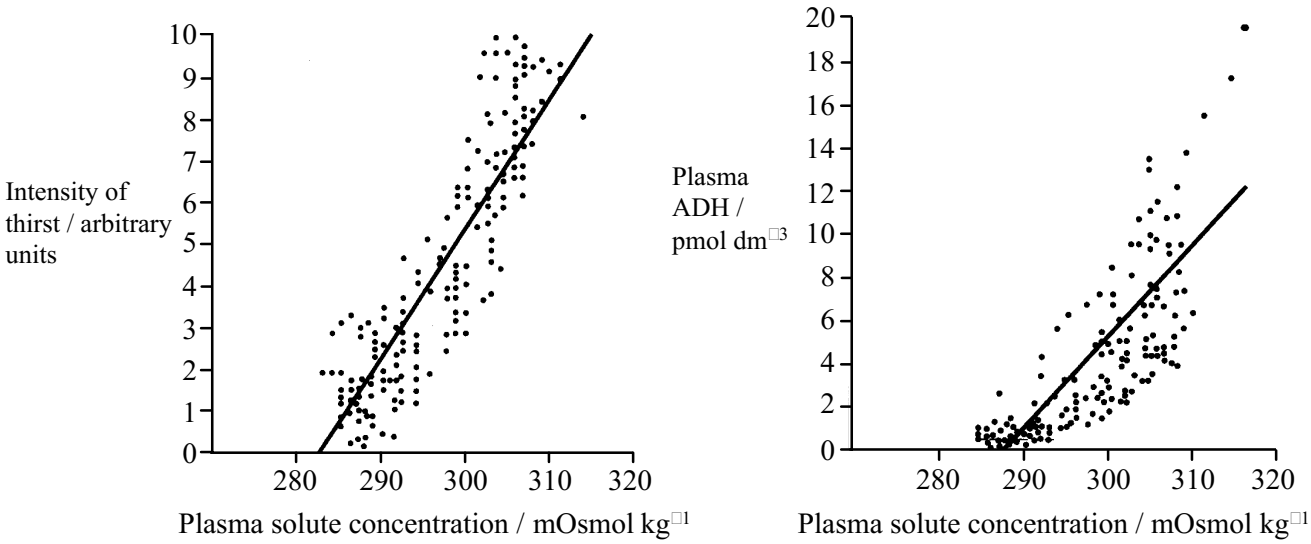
Option H – Further Human Physiology

H1. The plasma solute concentration, plasma antidiuretic hormone (ADH) concentration and feelings of thirst were tested in a group of volunteers. These graphs show the relationship between intensity of thirst, plasma ADH concentration and plasma solute concentration.



[Source: adapted from C J Thompson, *et al.*, (1986), *Clinical Science London,* **71**, page 651]

(a) Identify the plasma ADH concentration at a plasma solute concentration of 300 mOsmol kg□1 using the line of best fit. *[1]*

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(b) Compare intensity of thirst and plasma ADH concentration. *[1]*

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(c) Outline what would happen to plasma solute concentration and ADH concentration if a person were to drink water to satisfy his/her thirst. *[2]*

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(This question continues on the following page)

(Question H1 continued)

(d) State **two** reasons why a person's plasma solute concentration may increase. *[2]*

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H2. (a) Distinguish between exopeptidases and endopeptidases. *[1]*

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(b) Explain why pepsin is initially synthesized as an inactive precursor and how it is subsequently activated. *[3]*

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H3. (a) Distinguish between the mode of action of steroid hormones and peptide hormones. *[4]*

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(b) Explain the mechanisms used by the ileum to absorb food. *[6]*

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